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Volume XXIV OCTOBER, 1937 Number 4

WATER SANITATION AND THE PLANNING MOVEMENT

By Samuel M. Ellsworth, Member*

(Presented at a meeting of the Sanitary Section of the Boston Society of Civil Engineers, February 17, 1937)

From the beginning of the adoption by the Federal government of its policy of unemployment relief through the construction of public works in the early years of the depression, construction projects having to do with water sanitation, including water works, water purification plants, sewerage and sewage treatment works have been looked upon with special favor by the several Federal agencies responsible for the allotment and distribution of unemployment relief funds. While various phases of the administration of work relief organizations may be open to criticism, on the whole it must be admitted by all who have any knowledge of what has been accomplished during the past three years that the benefits to communities which have taken advantage of Federal financial aid have been substantial. The financial support which has been given to water supply, sewerage, and other projects relating to general sanitation by Federal authorities undoubtedly has done much toward impressing upon the mind of the public at large the importance of sanitation.

The question naturally arises in the minds of sanitary engineers and others as to what effect the recent Federal activities will have on future progress in the field of water sanitation, particularly when and

* Consulting Engineer, 12 Pearl Street, Boston, Mass.

if Federal financial assistance is withdrawn. There are several possibilities. The impetus given to the construction of such projects since the beginning of the depression may have been sufficient to cause individual communities to continue their activities in this type of public work. On the other hand, so much has been done in this direction during the depression that future municipal appropriations for water supply and sewerage may be reduced appreciably.

An influence which should have considerable effect in extending the gains made during the past few years and in stimulating future activities is that being exerted by our national, state and local planning agencies. Community planning is not a new thing; but during the depression, planning on a national scale became one of the major interests of the present administration. A little over two years ago there was organized a temporary Federal planning agency known as the National Resources Board, which, according to the preface of the report of this Board to the President, undertook "The first attempt in our national history to make an inventory of our national assets and the problems related thereto." A prominent place was given in the Board's report to water resources. Subsequently a National Resources Committee was appointed to continue the work of its predecessor, the National Resources Board. Among its other planning activities, this Committee has recently attempted to lay the groundwork for a future program for the protection and conservation of the nation's water resources. Public water supply, sewerage and sewage disposal, and problems pertaining to the pollution of rivers and coastal waters occupy an important place in this conservation program. Having participated in the work of both of these Federal planning agencies, the writer has frequently speculated upon the outcome of this movement.

The practicing engineer, as a result of his contracts with municipal authorities, manufacturers and business men in general, may be somewhat skeptical regarding the practical application of the idealistic programs and comprehensive plans of professional planners and planning agencies. The engineer devotes much of his time to what might be called planning, but always due weight must be given to practical and economic factors. The professional planner, however, frequently places his emphasis on securing an ideal plan from the standpoint of its social benefits, with little or no consideration being given to practical and economic limitations. With increasing public support being given to planning movements, it seems evident that planning specialists, boards and commissions are to play an important part in the future development of this country. The success of the movement, however, would

seem to depend in some measure upon maintaining a reasonable balance between the idealism of the planner on the one hand and the realism of the engineer on the other.

Many close observers of social and economic trends believe that the last five or six years have marked a turning point in the life of this country. Whatever philosophy of government we may hold, it must be admitted that many of the measures relating to our social system which have been put into effect or proposed during the last few years are essentially sound, in theory at least. While some will question the wisdom of much that has been done recently in the name of social planning, it seems probable that even greater emphasis will be placed upon this phase of our national life in the future than has been the case in the past. If this be true, those of us who find ourselves in the field of water sanitation should attempt to define our position and to visualize the future opportunities for public service in this field.

The use of the term "water sanitation" may require a word of explanation at this point. In the field of sanitary engineering, water problems have occupied such an important place that there is a tendency to think of sanitary engineering as applying only to water; whereas the field, properly defined, embraces numerous phases of public sanitation which are in no way concerned with water problems. Furthermore, a strict interpretation of the term "sanitation" limits us to matters pertaining only to health; whereas sanitary engineering, as we know it, is not confined to questions of public health alone, but includes many problems of environmental control which bear little or no relation to health. It is in this broader sense that the term "water sanitation" is used here.

The science and practice of water sanitation in this country have been under active development hardly more than fifty years. While many of the fundamental principles of the science were established in the early years of this period, widespread public recognition of water sanitation as a science has come mostly since the World War. While considerable had been accomplished in the field of public water supply and sewerage prior to 1890, especially by our largest cities, the design of such works as far as their public health aspects were concerned depended mainly upon the good sense of the designer rather than upon the application of established principles of sanitary science. The period from about 1890 up to the time of the World War was marked by outstanding scientific development and achievement in water sanitation. Many of the fundamental principles of the science were established in the early years of this period. Probably the greatest advance from the

standpoint of practical application came in the field of public water supply. Filtration and other methods of treatment were introduced and perfected. Most important of all, the public at large was made to realize the value of pure water and to recognize that expenditures for the sanitary protection of water supplies should take precedence over most other public works enterprises. While this period saw substantial development in sewage and industrial wastes treatment, public interest was only lukewarm to proposals for pollution control and abatement measures except in cases where sanitary conditions had become unbearable.

The period beginning with the close of the World War found sanitary engineering and its allied branches firmly established both from the standpoint of scientific background and public recognition. There is probably no better example of what could be accomplished by the application of modern sanitary science than that given by the record during the World War. Never before had such precautions been taken to safeguard the water supplies of troops in the field. Considering the millions concentrated in camps, here and abroad, the absence of any serious outbreak of water-borne disease during this period spoke in high tribute to the accomplishments of workers in the field of water sanitation. Undoubtedly the accomplishments during the war had considerable educational value and won support for peace-time activities in water sanitation movements that flourished during the period of industrial expansion which began early in the last decade. This period may be considered as one of refinement. The stage was set for an expansion in every branch of water sanitation, and, while protection of the public health continued to be the chief objective, greater attention was given to the esthetic phases of the science than ever before.

At the present time we may say that water sanitation both scientifically and from the standpoint of public recognition is a firmly established, going concern. Universities and technical schools for the past twenty years or more have been training sanitary engineers and chemists for work in water sanitation, and their graduates have entered the services of local, state and national public health agencies as technicians, research workers or administrators. Many have become associated with the research departments of private organizations, and others have entered the private consulting field. In practically every state in the Union where sanitation problems are important, bureaus of sanitary engineering have been established, generally under the various state health departments, and these bureaus have begun to exert a major influence on all matters pertaining to water sanitation.

Especially since the World War, technical societies and scientific journals have played an increasingly important part in the development of water sanitation. The opportunities afforded by technical journals for the exchange of information on the results of research and on the design and operation of sanitary engineering works have had a profound influence in stimulating a healthy growth in this branch of sanitary science. Through the medium of these journals the chemist, the biologist, the engineer, the public health administrator, the manufacturer and other allied workers in the field of water sanitation have been able to keep in touch with new developments.

It is quite apparent from the foregoing remarks that the field of water sanitation is well organized in all its branches to render whatever service may reasonably be required of it. With research becoming ever more productive, with public administration in water sanitation constantly improving, with more and more qualified engineers and technicians entering the field, and with the resourcefulness of manufacturers in developing, testing and promoting their products and equipment, stimulation of public interest in, and support of, needed projects is all that is required to make the next few years a period of outstanding activity and accomplishment.

It seems reasonable to expect that the needed stimulation of public interest in water sanitation may be furnished in part, at least, by the development of a national water plan. Considering the part played by the Federal government during the depression in assisting in the financing of water-use projects, it was natural that the various Federal agencies concerned would recognize the need for a well-conceived program which could be used as a basis for the allocation of financial assistance. While it was probably realized that an adequate program could not be formulated in time to be of much service during the critical period of the depression, from many standpoints no better time could have been selected for the organization of a national planning movement.

The first major accomplishment in water planning on a national scale was the report of the Water Planning Committee of the National Resources Board, which was completed and published about two years ago. This report was essentially an inventory and statement of condition as regards the water resources of the country. An attempt was made to give what might be called a bird's-eye view of the nation's water resources, and how they were being used; and brief consideration was given to the outstanding water problems in the various sections of the country. As would be expected in a discussion of water problems from a national viewpoint, the division of the country was made accord-

ing to drainage basins, with little or no consideration being given to state lines. Such recommendations as were presented in this report were concerned mainly with the need for a permanent national planning agency which would attempt to formulate the basis for a national policy with regard to water resources and develop a general plan of water conservation. It was suggested that detailed studies be made at once in certain representative drainage basins where interstate interests were involved, and where serious problems of water-use had resulted from many conflicting interests. It was intended that these studies should be directed toward the formulation of a comprehensive plan for conservation and development in each of the suggested basins, due consideration being given to the various uses to which the waters of the basins might best be employed.

In New England the Connecticut River Basin seemed to offer unusual opportunities for water planning on a comprehensive scale, and this basin was recommended by the Board for intensive study. Although its area is but slightly more than 11,000 square miles, it includes areas in four states; namely, Vermont, New Hampshire, Massachusetts and Connecticut. While the water resources of the basin have been responsible in a large measure for the growth and general prosperity of this region, until recently little or no consideration had been given to the development of a water-use plan for the basin as a whole. Under the divided authorities of four states whose interests were frequently conflicting, and with individual communities and industries interested only in their own particular water problems, orderly and economic development of these water resources has been almost impossible. In such matters as flood control, water power development and stream pollution, the need for a basin-wide policy has been forcibly demonstrated in recent years. Some ten years ago extended litigation resulted from the proposed diversion of flood waters by Massachusetts for water supply purposes in the eastern part of that state. Connecticut contested the right to such diversion, claiming damages to navigation and water power privileges, damage to agricultural lands, loss of dilution for the disposal of sewage and injury to fish life. Fortunately Massachusetts was permitted to proceed with its plans, especially since a considerable sum of money had already been spent on the construction of diversion works. While this is only one example of the many problems arising from conflicting interests in the use of the waters of this basin, it serves to illustrate the need for interstate, co-operative planning, and explains in part the recommendation of the National Resources Board with reference to the Connecticut River Basin.

Shortly after the report by the National Resources Board a new Federal agency was established to continue the water planning activities of the National Resources Board, namely, the Water Resources Committee of the National Resources Committee. The Water Resources Committee, as organized in 1935, consisted of twelve members, with Mr. Abel Wolman, chief engineer of the Maryland State Department of Health, as chairman. On the Committee were represented several Federal bureaus, including the Soil Conservation Service, the Biological Survey, the Geological Survey, the Corps of Engineers, the Bureau of Reclamation, the United States Public Health Service, the Federal Power Commission and the Tennessee Valley Authority. Three of the members, in addition to the chairman, consisted of engineers or scientists not connected with any other Federal service. While the Water Resources Committee since its organization has undertaken a number of important investigations relating chiefly to planning, and in connection with specific problems in various parts of the country, its outstanding accomplishment was in the continuance of national water planning started by the National Resources Board.

In co-operation with various state and regional planning boards the Committee has recently prepared what might be considered a tentative report* upon some of the outstanding needs in regard to the future development of the nation's water resources. In the preparation of this report the Committee endeavored to show the relative importance of water problems in each major drainage basin, and to set up a tentative program of projects for the correction of these problems. An attempt was made to group the projects in the order of their importance, although it was realized that any such arrangement must necessarily be only suggestive and subject to change. In the preparation of the report projects were classified under three headings: those of first priority, which were ready for construction or warranted immediate study; those either of second priority, in which construction was less urgent or those which, while desirable for immediate construction or study, involved some unsolved question of public policy, or legal, administrative or other difficulties; and a third group of projects of indeterminate priority. In this last group were included projects which were either not urgently needed in the immediate future or were of a controversial nature.

The projects presented by the Committee included practically every phase of water-use and development, such as water supply, sew-

* Since the preparation of this paper the report has been published under the title of "Drainage Basin Problems and Programs," and may be obtained from the Superintendent of Documents, Washington, D. C.

erage and sewage treatment, water power, flood control, navigation, drainage, irrigation, erosion control and recreation. Various Federal and state agencies participated in the preparation of these project lists, while the state planning boards, in general, took a leading part in assembling information on water projects. Other state agencies, especially state health departments and public works departments, rendered notable service in this connection. To facilitate the collection and organization of data, the country was divided into a number of major districts: New England, for example, being considered as one district, designated as District No. 1. These major districts were divided according to their principal drainage basins. In the case of New England five divisions were made as follows: the rivers of Maine, the Merrimack Basin, the Eastern Massachusetts Basin, the Blackstone–Thames–Taunton Basin, and the Connecticut–Housatonic Basin. The studies, reports and project lists for District No. 1 were prepared under the general direction of Prof. H. K. Barrows of Boston, regional consultant for the National Resources Committee in this district. Prof. William A. Liddell, who has been associated with the New England Regional Planning Commission on water problems, took an active part in the preparation of the New England reports, while the writer acted as associate consultant on matters pertaining particularly to water sanitation.

In each river basin an attempt was made by the water consultant to point out those water problems having basin-wide significance. Thus, in New England, water pollution problems were given first consideration in most of the drainage basins. Flood control and water power, particularly in the Connecticut and Merrimack basins, were also considered to be of major importance. Essentially, the preparation of a list of water projects, grouped as far as possible according to priority, was the main objective. Considering the limitations as to time and technical personnel it was recognized by most of the members of the staff that this report could only be considered as tentative and preliminary, its chief value being in indicating the immensity of the nation's water problems and in forming a basis for future planning.

For the most part the projects contained in the project lists were assembled through local agencies. To the district consultant and his staff was assigned the task of selection, classification and arrangement. These lists when submitted to the Committee and its staff in Washington were reviewed and revised where necessary to conform to the general principles set up by the Committee. The Committee attempted as far as possible, especially in cases where fundamental questions of policy arose, to consult with the district representatives. Obviously there were

instances where projects which deserved months of careful study were arbitrarily included, but usually in such cases a project for further study was recommended. While an earnest attempt was made to secure the co-operation and advice of local authorities, the results were not always satisfactory. There is reason to believe that the objectives of the Committee were not fully understood by such authorities, and furthermore in some localities there was a natural antipathy to any movement which might result in the extension of Federal powers over local or sectional interests.

Considering the report of the Committee as a first step, it would seem to be an outstanding contribution to water planning. If only to encourage criticism and discussion on the part of local interests, it will serve a most useful purpose. In addition, it should tend to stimulate what might be termed "basin-consciousness," wherein water problems may be thought of in terms of a river basin rather than from a strictly local or state viewpoint.

Obviously, if we are to derive the greatest benefits from the work which has already been accomplished by the National Resources Committee, some provision should be made for its continuation and expansion. Whether this is done by many regional or basin planning agencies or by one large Federal agency or by a combination of regional and Federal authorities would seem to be immaterial. From present indications it seems probable that some form of a permanent national planning agency will be established in the near future, and water planning on a national scale will become a permanent activity of the Federal government. Our state planning boards will probably continue to give increasing attention to water problems, and, judging from recent legislation, the formation of river boards or drainage basin authorities is likely to become an important factor in dealing with such problems.

There is a fair possibility that future planning activities will be directed by those whose main interest lies in comprehensive planning. In recent years we have witnessed the growth of a new profession, that of scientific planning. This profession found its first expression in the field of city and town planning and has gradually extended into state, regional and national affairs. The functions of the professional planner are concerned more with ultimate objectives than with the means by which such objectives are to be attained. Thus, in developing the ideal plan, practical limitations, either technical or financial, are likely to be overlooked. While it is desirable that the planner be assisted by advice on technical and financial questions, too frequently the opportunity for securing such advice has not been available. In the field of water sani-

tation it is essential that planning agencies concerned with this subject should have available full knowledge of the basic principles and considerations which guide the activities of experts in this field. Without such assistance there is danger that projects may be proposed and built involving costs which are not consistent with the benefits to be derived therefrom and with money that could be employed to better advantage elsewhere. For example, in the matter of stream pollution, projects may be recommended involving esthetic considerations only, whereas needed water improvements directly affecting the public health may be considered of secondary importance or entirely ignored.

Heretofore much of the progress in water sanitation has been based upon improving and safeguarding the public health. Where it could be shown definitely that the health of the public was being jeopardized by a polluted water supply, and particularly where actual cases of disease and death had resulted from the use of such a water supply, public support has been readily given to corrective measures. On the other hand, numerous projects in the field of water supply and sewerage have been promoted by reason of a general desire on the part of the public for ordinary cleanliness. In other words, esthetic considerations have often been effective in arousing public interest. With the knowledge that methods were available to improve the appearance or taste of a public water supply, for example, communities have become more and more willing to appropriate money for such improvements. Likewise in matters of river and harbor sanitation, regardless of health aspects, the desire for general cleanliness has resulted in many improvements. In the great majority of cases, however, whether concerned with public water supply or pollution abatement, the appeal in financing improvements has been directly or indirectly based upon the protection of the public health.

As a recent example of public response to health protection measures the situation during the 1936 spring floods in New England may be cited. During this period popular demand for protection against the spread of water-borne disease reached a pitch bordering on hysteria. The response by the public to protective measures initiated during this emergency by public health authorities was immediate. However drastic any proposal might have been, the public stood ready and willing to co-operate. The press and radio reports during this period contained frequent references to the health aspects of the flood, although much of the information given out indicated a lack of knowledge regarding some of the most elementary principles of sanitation. Undoubtedly the ready response of the public accounted in no small measure for the fact that no serious epidemic of water-borne disease resulted from this flood.

Here, at least, was an excellent demonstration of the enlightened attitude of the public regarding the relation between water sanitation and health. Furthermore, it is indicative of the support which can be secured for a water sanitation measure where the appeal is based upon protection of public health.

In view of the readiness of the public at large to support health measures there is a temptation to overstress health benefits in cases where such benefits may be of little or no significance. It is important in the promotion and development of water sanitation projects that their aims, objectives and benefits be clearly defined. Thus, if the objective is solely one involving esthetic benefits, this should be made clear. In this connection there appears to be an obligation on the part of the profession of water sanitation, as a whole, to clarify its functions and objectives for the guidance of public action.

Of the more obvious objectives regarding which there should be little disagreement among sanitary engineers, the maintenance of our existing water sanitation works, particularly those works which have been constructed primarily as safeguards to public health, is of first importance. It should be a fundamental duty of every specialist in this field to impress upon the public the danger involved in neglecting such works and the importance of making adequate provision for their maintenance and supervision.

Second in importance is the construction of new projects which are obviously needed for the protection of public health. There are hundreds of small communities throughout the nation where water supplies and sewerage facilities are needed in the interests of public health. In many cases, these communities have not been able to finance the construction of such works; and in the interests of the health of the country as a whole, it may be justifiable for the Federal government, even after the present emergency activities have ceased, to aid in financing these projects.

When proper consideration has been given to these classes of projects, there remains a large field of activity in water sanitation involving projects having little or no direct bearing upon the public health. The possibilities here are so great that only by careful study can we arrive at even a rough approximation of the direction and order in which to proceed. Since the problems are for the most part outside the scope of public health control, whatever action, if any, is to be taken in their solution will be determined chiefly by economic factors. It is in this field of semi-public or non-public health water sanitation that comprehensive planning is likely to be most valuable, and where the greatest opportunities exist for sanitary engineers and allied interests.

From a practical standpoint the question arises as to what agency is to sponsor and develop a plan of procedure, and, when developed, how is it to be made effective. While individuals and private groups concerned with water sanitation are obviously capable of undertaking this task, it seems almost essential that any plan which is to receive the support of the public at large be sponsored at least by some governmental authority. Even with Federal or state sponsorship, planning, as we commonly think of it, is only suggestive or advisory. However, the influence of a planning agency so organized and constituted as to merit the confidence and support of the public and the legislative branches of our government can be of substantial value even though it lacks statutory powers to force the adoption of its recommendations. Obviously, if such agencies seek the advice and views of well-informed private individuals and groups, and other qualified governmental agencies, their influence should be greatly enhanced. Specifically it is of primary importance that a planning agency dealing with water sanitation should give due consideration to the views of the whole profession. The profession, on the other hand, should be so organized that its opinions and views can be effectively impressed upon the public either directly or through a planning agency.

In conclusion it may be said that as a result of the recent activities in national water planning those of us who are concerned with water sanitation will have a better idea of the extent of the problems which lie ahead, and of the opportunities for service in this field in the future. If public interest in water sanitation can be sustained and stimulated, there seems to be little question but what the full capacity of our profession in man power and technical and administrative ability can be employed to good advantage to ourselves and to the public in general. To a large extent those concerned primarily in planning activities will have a substantial influence in guiding public action. If only for this reason the water sanitarian should take an active interest in national or large scale planning movements. Furthermore, his advice, particularly in matters pertaining to professional practice and engineering economics, is an essential counterpoise to the aims and functions of planning agencies and professional planners. Finally, if the present trend toward increased participation by the Federal government in the control and conservation of water resources is to continue, it would seem essential to the best interests of all concerned that those in the profession of water sanitation having no official connection with such matters be so organized as to have an effective influence in the future of water conservation.

WEATHER FORECASTING

By Charles F. Brooks *

(Presented at a meeting of the Boston Society of Civil Engineers held on April 21, 1937)

Daily Forecasts

The United States Weather Bureau twice daily issues a set of weather forecasts for the public which includes different forecasts for separate States or even portions of States, and also particular forecasts for cities in which "regular" stations of the United States Weather Bureau are located. In publishing these forecasts many newspapers carry also a simplified weather map and discussion of the last set of reports received generally from throughout the United States and Canada.

On April 21, for example, the United States Weather Bureau predicted "For Massachusetts, New Hampshire, Vermont, Rhode Island and Connecticut: Rain tonight and Thursday; not much change in temperature." For Boston and vicinity this was amplified to "Cloudy with light rain beginning late tonight or Thursday; not much change in temperature; lowest tonight in the middle or lower 40's; moderate northeast to east winds."

The map for this day, reproduced three columns wide in the "Boston Evening Transcript" (Fig. 1), shows a large high pressure area over Quebec and northern Ontario, and a pronounced low centered in Illinois. Polar air masses covered the northern United States and eastern Canada, meeting tropical marine air from the Gulf of Mexico on a front extending from the center of low pressure to the Virginia Capes; and modified polar Pacific air met the tropical air on a front extending from Illinois to southern Texas, and met the polar continental air on another front from Illinois to southwestern Minnesota. The fronts are not shown by lines, but by accordant sharp points in successive isobars.

Local signs would have led an amateur forecaster to much the same prediction. The sky had been clouding over and becoming increasingly dark with a somewhat fibrous sheet cloud which was growing smooth. A chilly wind from the northeast was also blowing. It would not have

* Professor of Meteorology, and Director, Blue Hill Observatory, Harvard University.

been possible for the local prognosticator, however, to say confidently about when the precipitation would begin, whether or not it would be light, and about what the temperatures would be. Furthermore, he could not have said these things as early as 9 or 10 in the morning, for precipitation to begin twelve hours later. Herein lies the advantage of having the numerous definite weather reports, which are represented in a general way by the few published on the newspaper map.

The Daily Weather Map

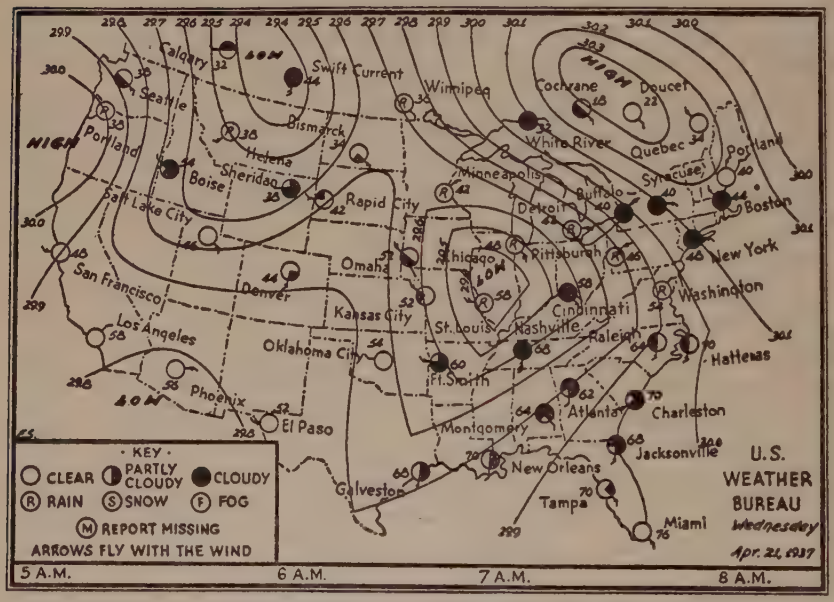

FIG. 1. — UNITED STATES WEATHER BUREAU'S DAILY WEATHER MAP FOR 8 A.M., APRIL 21, 1937, AS PUBLISHED IN THE "BOSTON EVENING TRANSCRIPT"

Let us consider the needs of the forecaster more in detail. He must have maps of the surface weather over a wide area at frequent intervals. The American network of stations provides reports from about three hundred places every twelve hours and from a selected number at shorter intervals. Full reports should be rendered every six hours, to provide a better opportunity to follow important short-time developments. General maps, however, are now made at airport stations from several hundred reports every six hours, and local maps may be con-

structed even every hour. Selected ships at sea report by radio every twenty-four hours or oftener, — at short intervals during severe storms, especially hurricanes.

The data from land stations are sent by telegraph to district forecast centers, and by teletype on airways circuits. The reports from the Arctic, also Mount Washington, and from ships and some island stations come by radio.

Upper air reports are essential for exact information about the body of the atmosphere where much of the weather is made. These reports

FIG. 2. — THE STAGE OFFICE OF THE MOUNT WASHINGTON AUTO ROAD COMPANY, USED BY THE MOUNT WASHINGTON OBSERVATORY, 1932–37

Note the sea of clouds below

(Photograph by W. H. Pote)

are available from mountain stations, cloud observations, the courses of pilot balloons, airplane ascents, and ascents of balloons carrying radiometeorographs.

MOUNTAIN STATIONS

There are eight mountain stations in the United States, at heights of 4,000 to 14,000 feet, the best known of which is our Mount Washington Observatory. (See Fig. 2.) Mount Washington, at 6,284 feet above sea level, often finds its head in decidedly different weather from that about its foot. While New England may be under a layer of cold air several thousand feet deep, the mountain may feel the warmth of a

southerly wind. The sky may be so covered with clouds that lowlanders can see nothing above a moderate height, yet the mountain top may be enjoying fair weather. At other times, however, clouds seen from below may extend to a height much above the summit of the mountain, thereby enveloping Mount Washington in fog. In fact, in winter the summit is so enveloped more than half the time.

The temperature on the mountain when a storm is approaching has been found to indicate very well whether or not the air high over

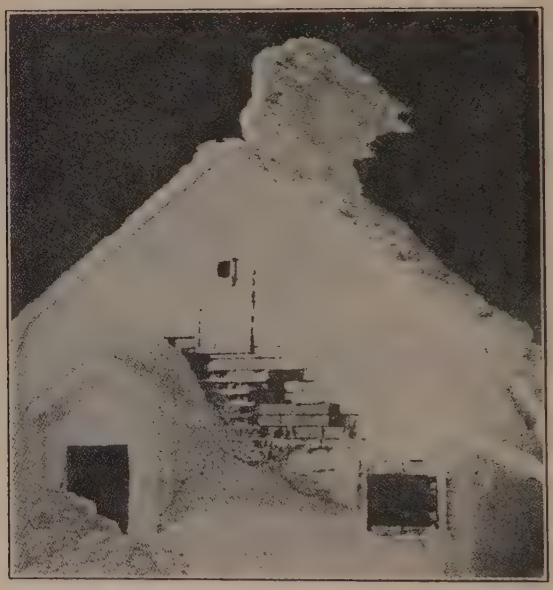

FIG. 3. — MOUNT WASHINGTON OBSERVATORY BUILDING COATED WITH RIME. THE MASS OF ICE ABOVE THE BUILDING COVERS THE ANEMOMETER

Boston will rise above freezing and insure rain, or remain below freezing and permit only snowfall. Above 15° F. pretty definitely indicates rain; below 10°, snow.

The severity of the climate on Mount Washington, which is truly Arctic, has made necessary the development of special apparatus for obtaining the records of the different elements. Owing to the frequent formation of rime, — mountain frostwork, — from the freezing of the liquid droplets of clouds on to solid objects (Fig. 3), it has been necessary to make an electrically heated anemometer (Fig. 4). The rotating cup

system (Fig. 5) is greatly reduced from the usual Weather Bureau size, and is held close about a powerful heater (Fig. 6) which, in almost any weather, can keep the temperature of the rotating portion above freezing. With such a device it has been possible to measure winds not infrequently in excess of 150 miles per hour, and once in the neighborhood of 200.

FIG. 4. — MOUNT WASHINGTON HEATED ANEMOMETER
(Photograph by H. G. Dorsey, Jr.)

For the measurement of precipitation it is essential to surround the gages with inverted conical wind shields of the Nipher type (Fig. 7), to prevent local currents induced by the gages from guiding the snowflakes away from the gage, or from eddying the snow out of the gage. Also, the gages and shields must be tilted, so that their receiving surfaces are parallel to the slope up which the wind comes. The result is that the gage so exposed catches what we hope is a true sample of what falls on

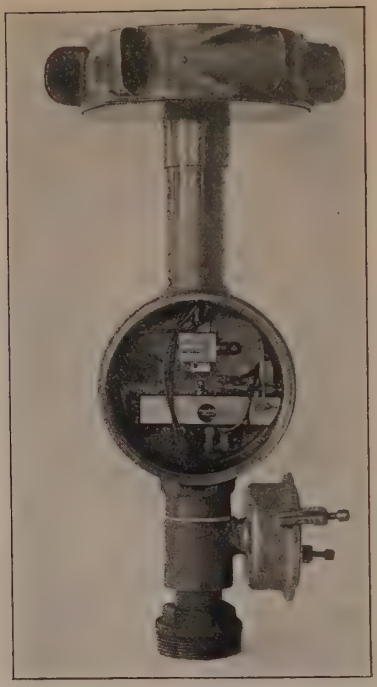

FIG. 5. — MOUNT WASHINGTON HEATED ANEMOMETER
The rotor (top) is an inverted copper disk 6 inches in diameter, from which the wind-catching ears protrude
(Photograph by Mann (now Mico) Instrument Company)

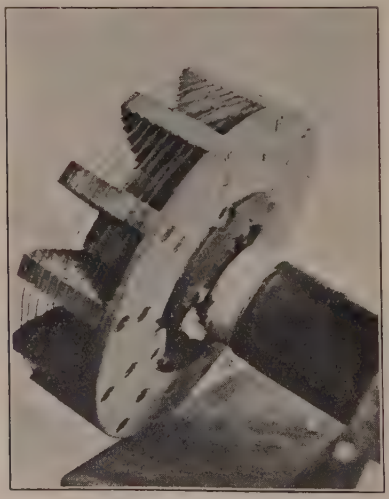

FIG. 6. — THE ELECTRICAL HEATER IN THE MOUNT WASHINGTON ANEMOMETER

the surface. Unfortunately, it is not possible to prevent the gage from catching drift snow. An attempt will be made, however, to expose the gages several feet above the surface.

Another problem is how much water may be expected from the impingement of cloud droplets on a mountain, making the rocks wet in summer or forming rime in winter. Another is the degree of turbulence suffered by the wind in passing over the summit. This can be observed by means of balloons watched from two theodolite stations.

Fig. 7. — A Nearly Ideal Shield on Mount Washington

Such problems as these and other interesting conditions on a stormy mountain, as well as the study of mountain weather data for the improvement of lowland forecasting, have led to a definite organization of the Mount Washington Observatory and the formation of a non-profit corporation to operate it. In the work of the Observatory the United States Weather Bureau and Harvard University, through the Blue Hill Observatory, co-operate. The Observatory derives some of its support from the State of New Hampshire and the New Hampshire Academy of Sciences, the Appalachian Mountain Club and other interested organizations, and many individuals.

The observing station on Mount Mitchell, North Carolina, has recently been established. It immediately proved its worth, just before the President's inauguration, when, while the eastern United States was blanketed in low clouds, it reported alto-stratus moving from the south; thereby indicating overrunning tropical air, which gave the forecaster in Washington the essential basis for his prediction of rain for the inauguration. This forecast was fully verified!

Cloud Observations

Cloud observations, including the forms of clouds and their directions and angular velocities of movement at different levels, tell much of what is going on aloft. The forms indicate processes, while the movements show the overlapping of the winds. In clear weather and on days with very low clouds, however, little can be learned by this method. On April 21 the sequence of clouds indicated the sloping ascent of the tropical maritime air, which had to leave the ground a thousand miles southwest of us and ride upward at a gentle angle over the polar continental air which has covered our region. The cooling during this ascent, caused by the expansion of the air as it reached higher and higher levels, condensed the tropical moisture first in the form of thin, filmy clouds at high levels, and then, as the condensation became greater, in the form of a general sheet of snow cloud, which is now emphasizing the threat of coming rain, of which we were already forewarned by the Weather Bureau.

Balloons, Airplanes, Radio-Meteorographs

When the sky is clear or when clouds are high, the travels of pilot balloons, as observed by even a single theodolite at different stations, tell us the overlappings of winds at different heights (Fig. 8). The balloon is assumed to rise at a standard rate based upon a standard free lift before it is released. This assumption by many comparisons using two theodolites at once has been found valid in all but a small percentage of cases. As the balloon floats away its angular height and azimuth are observed minute by minute, and the results are plotted; the wind directions and velocities at all levels are thus obtained. Balloons are now released every six hours from about seventy stations in the United States.

To obtain such essential information as temperatures, humidities and pressures at different heights, it is necessary to employ an airplane

or a balloon. Kites were used for forty years, following the first experiments with recording instruments lifted by kites from Blue Hill in 1894. But the airplane is now much more efficient. At some twenty-seven stations in this country, airplanes are sent aloft shortly before dawn daily to fly to a height of 17,000 feet, carrying a meteorograph attached in a position freely exposed to the wind. The meteorograph scratches a record of temperature, humidity and pressure on a blackened cylinder turned by clockwork. The observations are read from the record as soon as the airplane lands, and then transmitted to the forecasting centers of the Weather Bureau.

FIG. 8. — BEGINNING OF A PILOT BALLOON ASCENT FROM MOUNT WASHINGTON

To the left is a wooden windshield about a snow gage

(Photograph by Harold Orne)

The use of airplanes for this purpose bids fair to be replaced by balloons carrying radio-meteorographs (Figs. 9, 10). It is cheaper to send a balloon up with an automatic instrument than it is to pay for the high ascent of an airplane. Radio-meteorographs have now been perfected to the point where complete returns of humidity, temperature and pressure can be sent by radio for every 400 feet of ascent, and at a speed whereby it will take only twenty minutes, instead of the hour or more by airplane, to reach 17,000 feet. Furthermore, in another twenty minutes, the atmosphere to a height of 34,000 feet is reported, and in an

FIG. 9

Harvard radio-meteorograph, Model F, with general sun-shield removed and box opened to show interior assembly. At the left is the radio transmitting set in a box of balsa wood. At the right are the exposed meteorological instruments, barometer below and thermometer and hygrometer at right, the former out of sight under shiny radiation shield. The clockwork is under the left middle portion of the cover and turns the black cylinder in the central group of three.

hour to 50,000 feet. The lightest radio-meteorographs now weigh about a pound, but improvements are in progress which will make them even lighter.*

Air Mass Analysis

When data from both surface and upper air stations have been assembled, it is possible not only to make a map of surface weather, but also several maps for different levels and cross sections of the atmosphere in different directions as well. When these have been constructed,

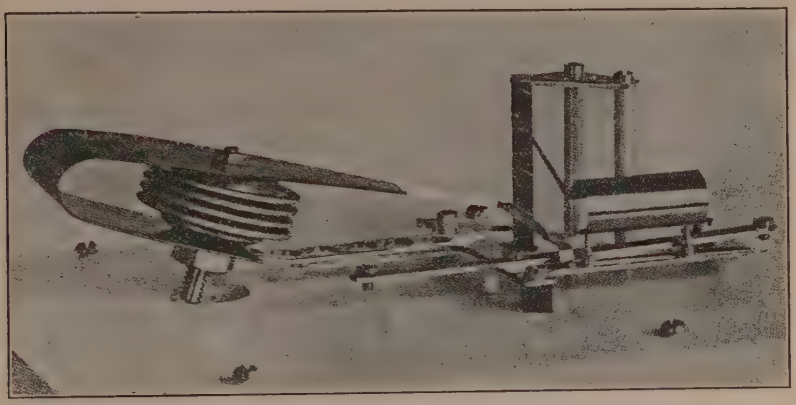

Fig. 10

The meteorological portion of the Harvard radio-meteorograph, Model F, with radiation shield over the bimetal thermometer (right) removed. The barometer is on the left, and the hair hygrometer in central foreground. The black vertical cylinder just left of center contains the turning helix of platinum wire flanked by insulating material against which rest the styles from the instruments through which the electrical circuit through the radio transmitter is closed whenever the platinum helix passes under.

it is possible to outline the limits of the air masses of different qualities and to study their interactions on the air mass fronts.† Figures 11 and 12 show results of air mass analysis as depicted on surface maps during the flooding rains of March, 1936, and a north-south cross section during

* October 25, 1937. The latest Harvard radio-meteorograph, designed by K. O. Lange, A. E. Bent and C. B. Pear, Jr., of the Blue Hill Observatory, weighs but three quarters of a pound and costs but $18. This instrument has been sent up daily from the East Boston airport beginning October 1, and is expected to replace the airplane ascents here after one month of comparisons have been obtained.

† An elementary exposition of air mass analysis, with many illustrations and a comprehensive bibliography, has been published by the American Meteorological Society, Milton, Mass., entitled "An Introduction to the Study of Air Mass Analysis," by Jerome Namias, in the Bulletin of the American Meteorological Society, June–July, 1936, Vol. 17, pp. 159–242. Price, 60 cents.

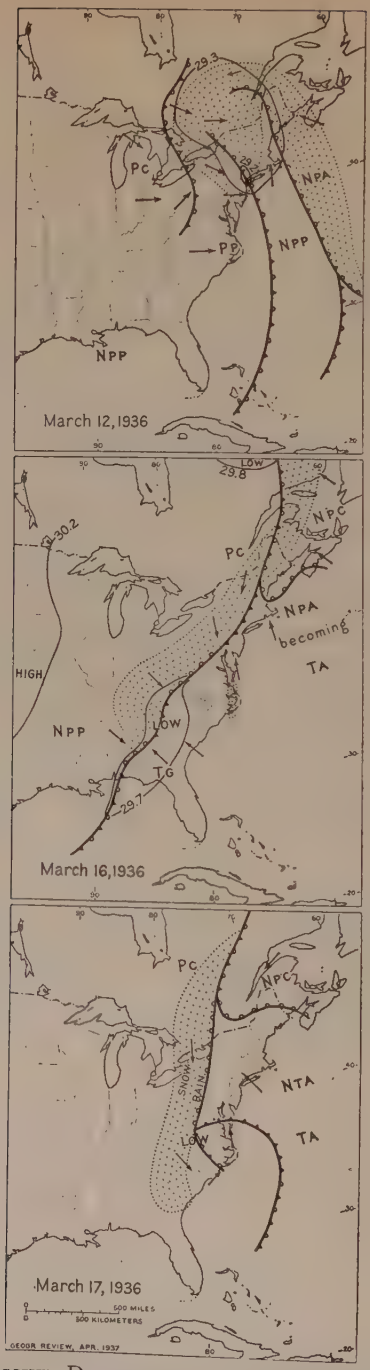

FIG. 11. — SUCCESSIVE DEVELOPMENTS IN THE WEATHER SITUATION, MARCH 12 TO 17, 1936, IN THE EASTERN UNITED STATES

(8 P.M. air-mass maps, courtesy of Massachusetts Institute of Technology. Reproduced by permission from the "Geographical Review")

the rains that produced the Ohio flood of January, 1937. After the surface and higher level maps have been made, the district forecasters make their forecasts. Unfortunately, the scientific air mass analysis is not completed in time for the forecaster to make much use of it in connection with the forecasts issued immediately after the morning or evening observations. He has at his disposal, however, the analysis made six

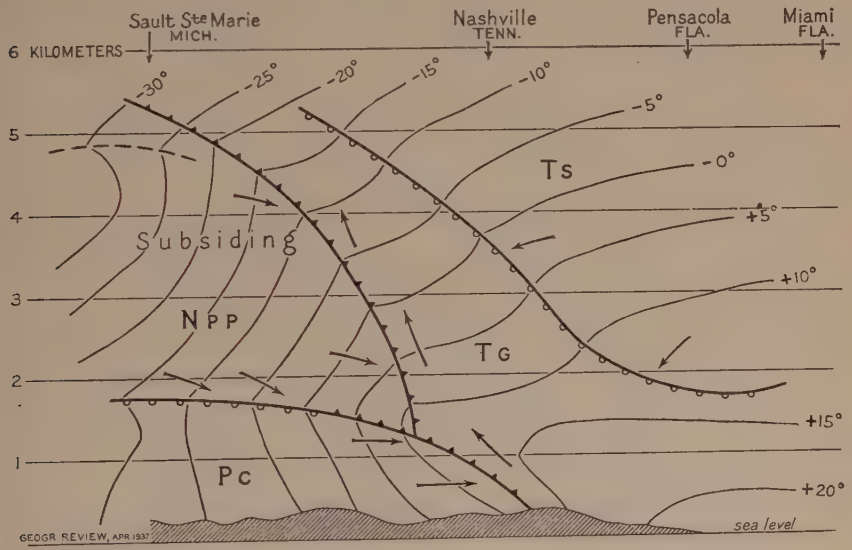

FIG. 12. — CROSS SECTION OF AIR MASSES AND FRONTS, NORTH TO SOUTH, AT 8 A.M., JANUARY 22, 1937

Warm and cold front shown by conventional symbols: *Npp*, modified Polar Pacific air; *Pc*, Polar Continental air; *Tg*, Tropical Gulf air; *Ts*, Tropical Superior air

(Courtesy of Massachusetts Institute of Technology. Reproduced by permission from the "Geographical Review")

hours earlier, which, with the partial analysis of the moment, enables him to use the air mass method to considerable advantage. The results of air mass analysis are distributed by teletype only an hour or two after the morning forecast is made.

By virtue of the hourly reports available by teletype or broadcast by long-wave radio from important airways stations, it is possible to construct hourly weather maps* for an area of several hundred miles

* *Cf.* W. H. Wenstrom, "Regional Weather Maps," and W. O. J. Roberts, "Hourly Regional Weather Maps for Amateur Observers." Bulletin of the American Meteorological Society, February, 1937, Vol. 18, pp. 41–46.

in all directions from any point, and from this, or a succession of these maps, to make detailed forecasts of considerable immediate value. For example, it is possible to predict the beginning or ending of precipitation within half an hour or an hour as much as two hours in advance. Also one can often tell just when snow may turn to rain or vice versa. Such maps are helpful, too, in the prediction of excessive rains, either local or general. Cold waves can be followed and their arrivals and rates of fall in temperature closely predicted.

For Improving Daily Forecasts

The outlook for improvement in daily weather forecasts is excellent. Good though present-day forecasts have become, meteorologists know how to make them better. The several bases for improvement are largely dependent upon appropriations from Congress. First, the present large forecast districts should be divided, making a dozen where we now have six. It is rather too much, for example, to expect one man to predict the weather for each State from Tennessee to Maine. We in New England think we have a rather special brand of weather, which has a considerable basis in fact, and this justifies us in urging that New England weather be forecast from Boston instead of from Washington.

Not only should the forecast districts be divided, but a 24-hour service should be provided. Air mass maps should be made every six hours as a basis for general forecasts for the entire district. Hourly maps should also be made from the airways reports, at least during the periods of storms or approaching cold waves, so that hourly bulletins could be broadcast by radio from the forecasting centers. Such forecast service is now available to aviators and should be available to the general public, particularly to transportation interests in winter.

For the best local forecasting it is desirable that the local climatic characteristics, which mark the prevalence of the different major air masses, be known to the forecaster. This involves a study of air mass climatology, in which means of temperature, humidity, etc., are made not simply by months, but according to the type of air mass present. Thus, for any month, we have a certain set of normals for the prevalence of the tropical air masses, and quite a different set for the prevalence of polar air masses. In fact, these should be subdivided to separate the polar continental air masses from the modified polar Pacific air, which frequently reaches us after crossing the continent.

The network of mountain stations should be considerably increased. There is much to be said in favor of the continuous records possible on

mountains; for from them arrivals of fronts can be definitely timed and compared with their arrivals in neighboring lowlands, thereby the sequence of weather aloft relative to that at the ground can be better understood, and forecasting improved.

It would also be well worth while to put more effort on to the movements and forms of clouds at different levels. Cloud observations are made at many stations today, but the time allotted to the cloud observations is so limited that only the major features can be reported, and only rough indications of directions and velocities. Furthermore, the observations are usually made at intervals of four to eight hours, so that the sequence of development is not available to the forecaster.

In view, however, of the limited areas over which mountain observatories are topographically possible and also the numerous occasions when cloud observations of value cannot be made, we must pin most hope for increased upper air data on a wider use of radio-meteorographs. The Weather Bureau is fully aware of the value such observations would have to them and would certainly welcome reports from, say, one hundred stations four times a day. This may sound visionary at present when plans are on foot for only a few experimental stations, but the success we have had here during the past few months with our new radio-meteorograph, as well as European experience with other designs, leads me to feel confident that we shall have these hundred radio-meteorograph stations reporting four times a day in the comparatively near future.

Long-Range Forecasting

The Weather Bureau has issued for several decades a forecast on Saturday morning, covering the general character of the succeeding week's weather, for example: "The weather outlook, for the North and Middle Atlantic States, is for rain over the middle and northern portions on Tuesday or Wednesday and again toward the end of the week. Moderate temperatures are indicated." These forecasts have proved very useful, even though they must be couched in general terms and vaguely dated. The chief basis of these forecasts is the distribution of pressure over the eastern half of the North Pacific Ocean and over the northwestern and western portions of the continent. Germany has been more ambitious, and for the last few years has issued fairly detailed forecasts for ten days in advance during the summer months. A verification of distinctly better than chance is claimed on apparently adequate grounds. The following translation of one forecast will give some idea of the detail attempted:

[The present] not fully settled weather with alternate clearing and short, partly thundery rains will continue for the next few days. Then in the west and in south Germany for a few days prevailingly clear weather will come, while in north Germany, especially in the coastal region of East Prussia a slight changeableness will remain. Following that, over the whole country there probably will be another cooling and strongly unsettled weather with frequent precipitation due to the arrival of maritime and polar-maritime air currents. In the first half of the last third of July the temperature as the result of a sharp change will come to have a practically normal mean. In the second half, on the whole it will be cooler than normal. The number of days with precipitation in the last third of July in central north Germany and East Prussia will exceed 5 in most places, though on many days the showers will be merely insignificant. The duration of sunshine in south Germany in the 11 days will exceed 70 hours.*

These and similar forecasts by Dr. Franz Baur, who is in charge of Germany's official long-range forecasting bureau, are based on many elements, including the tendency of the weather to continue, the winds at the 5,000-foot level, the distribution of pressure areas in the eastern North Atlantic, and elsewhere.*

In India, seasonal forecasts of the monsoon rains have been made for a great many years. A recent one may be quoted: "The monsoon rainfall of August to September will be not less than 94 per cent of the average in the peninsular, nor less than 83 per cent of the average in northwest India."† Couched in such terms, these forecasts are generally correct. These India forecasts are based mostly on pressure conditions at key stations, some of them as far away as South America, which indicate the general intensity of the atmospheric circulations which control the strengths of the monsoons in India. Partly by logical hunting and partly by statistical combing the world for distant correlations, regression formulæ have been made for these India forecasts. Obviously, some of the apparent relationships found by these statistical studies may have no physical basis and may, therefore, not really help in the forecasts.‡ When the indications by the formula are rather weak, no forecasts are made.§ When they are strong, however, the formula apparently indicates enough of the physical control to make the forecasts likely to succeed.

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* Bulletin of the American Meteorological Society, May, August–September, 1936, Vol. 17, pp. 148–153, 253–254.

† *Cf.* C. W. B. Normand, "Memorandum on the Rainfall of June and July and the Probable Amount during August and September, 1936," 3 pages. Government of India, Meteorological Department, Poona, August 6, 1936.

‡ *Cf.* R. B. Montgomery, "A Discussion of Some of Sir Gilbert Walker's Forecasting Formulæ," presented at the April, 1937, meeting of the American Meteorological Society in Washington, D. C., and to be published soon.

§ "The evidence from the known factors is so conflicting that no forecast of practical value can be issued concerning this year's monsoon rainfall." Government of India, Meteorological Department, Poona, June 6, 1936.

Long-range forecasting is attempted elsewhere in the world, but in no places so consistently and with such success as in the three instances mentioned. Meteorologists are loath to make long-range forecasts even on strong statistical grounds, unless they can see a reasonable physical interpretation. Even when such interpretations are made, there is quite a chance that they may not be correct. Nevertheless, tentative forecasts are issued for some periods with a success which has economic value as, for example, those by Prof. G. F. McEwen, of the Scripps Institution of Oceanography, La Jolla, Calif., based mostly on late summer and early autumn sea temperatures there.* To mention other scientific attempts at long-range forecasting in the United States, I may refer to H. H. Clayton's weekly and monthly forecasts based fundamentally on the slow progressive movements of meions and pleions, areas of more or less persistent negative or positive departure of atmospheric pressure. Mr. Clayton recognizes behind the movements of these meions and pleions a certain control by variations in the solar constant.† Dr. C. G. Abbot, on the basis of cycles in solar constant values and other apparent relations to weather, has been making trial forecasts for several stations in the United States, covering many months in advance. With due caution Dr. Abbot publishes these forecasts only after the weather has passed.‡

The United States Department of Agriculture is now engaged in an intensive study of various methods of long-range forecasting, including world-wide correlations of the weather, cycles, Arctic ice, and slow changes of ocean temperature. It is also fostering new attacks on the problem by studying the weekly changes in the distributions of the major pressure areas and air mass units in the northern hemisphere. In connection with this, too, there is an investigation of how the high pressure areas that come out of high latitudes in winter are formed; and airplane weather soundings at Fairbanks, Alaska, and in the McKenzie Basin of Canada have been established to provide data for this study.

The outlook for long-range weather forecasting seems hopeful, even though much of the success of optimistic scientific long-range forecasters seems on statistical scrutiny to have been due to chance as much as to science. There can be no doubt that there are major and minor swings in the earth's weather, and that these are interconnected over wide areas and persist and progress in definite manner from one season to

* *Cf.* Bulletin of the American Meteorological Society, October, 1936, Vol. 17, pp. 305–306.

† *Cf.* H. Helm Clayton, "Long-Period Weather Changes and Methods of Forecasting." Monthly Weather Review, November, 1936, Vol. 64, pp. 359–376, 21 illustrations and 7 tables.

‡ Smithsonian Miscellaneous Collections, Vol. 94, No. 10, 1935; Vol. 95, Nos. 12, 15, 1936.

another. We do not yet fully understand the causes of these swings. The small fluctuations in the radiation received from the sun may initiate these fluctuations, which are then continued by natural periods in the earth's atmosphere and hydrosphere. There are slow changes in ocean temperatures and the movement of bodies of water of varying temperature. There are the changes in the amount of ice in the Arctic regions, the variations in the land area covered with snow in winter, which exert an important influence on the distributions of air temperature and consequently of pressure. The sequences and persistences of these variations can be discovered statistically, but until we have a longer record of the weather to work with, their reality cannot be proved by statistical means. Nevertheless, when the relations found can be explained with considerable confidence on the basis of physical interrelations, then we may believe that an adequate basis for long-range forecasts has been found.

Of General Interest

JOHN R. FREEMAN SCHOLARSHIP

The John R. Freeman Fund Committee awarded a scholarship to Mr. Martin A. Mason on June 30, 1937. This scholarship is for the year 1937–38. Mr. Mason has been associated with the National Bureau of Standards at Washington, D. C. His plans indicate a year of interesting visits and study in European hydraulic laboratories.

American Society of Civil Engineers and Engineering Institute of Canada — Joint Meeting in Boston

The American Society of Civil Engineers acted as host to the Engineering Institute of Canada at a joint meeting in Boston, October 6 to 8. The total registration of those attending the meetings was 1,056. Many members of the Boston Society of Civil Engineers had an opportunity to attend the technical sessions, at which many papers were read on a varied field of engineering problems. Particular interest was centered on engineering economics and soil mechanics, and many other subjects, including building foundations, boring and sampling, city planning, Boston Harbor pollution, marine borers, and surveying and mapping in Massachusetts.

A very enjoyable event was provided for the officers of the American Society of Civil Engineers and of the Engineering Institute of Canada, sponsored jointly by the Northeastern Section of the American Society of Civil Engineers and the Boston Society of Civil Engineers. This event was a dinner held at the armory of the Ancient and Honorable Artillery Company in Faneuil Hall. As an expression of esteem and interest, the Boston Society of Civil Engineers presented the officers of both organizations with a book entitled "Open House in New England," by Samuel Chamberlain, as a memento of their visit to Boston.

Prof. Albert Haertlein, Chairman of the Northeastern Section, A. S. C. E., presided at the dinner, at which there were 180 members and guests.

PROCEEDINGS OF THE SOCIETY

MINUTES OF MEETINGS

Boston Society of Civil Engineers

SEPTEMBER 22, 1937. — A regular meeting of the Boston Society of Civil Engineers was held this evening at the Engineers Club, and was called to order by the President, Arthur D. Weston, at 7 P.M. Seventy members and guests were present. Fifty-eight persons attended the buffet supper.

The President announced the deaths of the following members: Charles H. Eglee, elected a Member May 18, 1910, and died July 4, 1937; William C. Hawley, elected a Member May 17, 1899, and died August 16, 1937; Frank A. McInness, elected a Member November 21, 1888, and died August 9, 1937.

The President reported the election of George Allo Macdonald to the grade of Member.*

The President introduced the speaker of the evening, Mr. Harry A. Hageman, Chief Hydraulic Engineer, Tennessee Valley Authority, who gave an illustrated talk on the "General Engineering Features of the Tennessee Valley Authority."

The meeting adjourned at 8.50 P.M.

EVERETT N. HUTCHINS, *Secretary.*

OCTOBER 20, 1937. — A regular meeting of the Boston Society of Civil Engineers was held this evening at the Engineers Club, and was called to order by the President, Arthur D. Weston. Fifty members and guests were present. Forty persons attended the buffet supper.

The President announced the deaths of the following members: Edgar S. Dorr, elected a Member May 16, 1888, and died October 5, 1937; Joseph Driscoll, elected a Member May 18, 1910, and died May 26, 1937; Harrison P. Eddy, elected a Member February 17, 1904, an Honorary Member February 21, 1934, and died June 15, 1937; Francis H. Kendall, elected a Member April 19, 1893, and died October 11, 1937; Joseph F. Ross, elected a Member May 17, 1905.

The Secretary reported the election of the following new members:

Grade of Student: Henry Campbell, Norman B. Cleveland, Richard C. Harrington, Oliva Edward Hintsa, John H. Manning, Philip G. Smith.

The President called upon Lieut. E. B. Roberts, in charge of the Boston office, United States Geological Survey, for a few brief remarks. He then introduced the speaker of the evening, Lieut. Paul A. Smith, United States Coast and Geodetic Survey, Washington, D. C., who gave a very interesting talk on "The Results and Methods of Recent Offshore Hydrographic Surveys," illustrated.

The meeting adjourned at 8.30 P.M.

EVERETT N. HUTCHINS, *Secretary.*

Sanitary Section

JUNE 12, 1937, ANNUAL EXCURSION. — An excursion to Leominster, Mass., was made on this date. The members of the Section and guests met at the Leominster Railroad Station at 2.30 P.M., and the party then proceeded to the Leominster Activated Sludge Sewage Treatment Plant. This plant is now under construction, and an excellent opportunity was afforded the party to see the plant at an interesting stage in its development. Mr. Frank L. Flood, of the firm of Metcalf & Eddy, explained the details of the plant.

* Transfer from grade of Junior.

The party then proceeded to the Leominster Water Treatment Plant. This plant consists of coagulation, sedimentation and rapid sand filtration, and the details of the plant were explained by Mr. W. G. Classon, Superintendent of the Water Department.

Thirty-three members and guests were present on the excursion. The party left the Water Treatment Plant at approximately 5.15 P.M.

RALPH M. SOULE, *Clerk.*

OCTOBER 7, 1937. — Upon invitation from the Sanitary Engineering Division of the American Society of Civil Engineers, the Sanitary Section attended the meeting held on this date in Parlor A at the Hotel Statler.

Mr. Arthur D. Weston and Dr. Gail P. Edwards presented a paper on "Studies of the Pollution of Boston Harbor and its Tributary Waters." The paper was discussed by E. Sherman Chase of Boston, Raymond R. Ribal of Oakland, Calif., and Richard H. Gould of New York, N. Y.

Prof. Gordon M. Fair presented a paper on "The Decomposition of River Deposits." This paper was discussed by Langdon Pearse of Chicago, Harold W. Streeter of Cincinnati, and Willem Rudolfs of New Brunswick, N. J.

RALPH M. SOULE, *Clerk.*

Designers Section

OCTOBER 13, 1937. — A meeting of the Designers Section was held at the Society Rooms on October 13, 1937. The Secretary's report of the May meeting was read and approved.

The Chairman then introduced the speaker of the evening, Mr. Henry A. Mohr, who spoke on "Recent Developments in the Construction of Deep Caissons."

An interesting discussion period followed the presentation of the paper, and the meeting adjourned at 8.30 P.M.

The attendance was 59.

J. D. MITSCH, *Clerk.*

APPLICATIONS FOR MEMBERSHIP

[October 20, 1937]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of fifteen (15) days from the date given.

For Admission

BARKER, CLINTON CARTER, Swampscott, Mass. (Born September 12, 1885, North Andover, Mass.) Student in civil engineering at Massachusetts Institute of Technology, 1903–08; since March, 1909, to date, with engineering department, County of Essex, Massachusetts, as rodman, transitman, chief of survey party, field engineer on highway construction, and draftsman, and as engineer's assistant in design of highways and bridges and inspector of dams and reservoirs, under the direction of Robert R. Evans, county engineer; for the past six years, and at the present time, acting as assistant county engineer. Refers to *H. B. Alvord, T. A. Appleton, R. R. Evans, J. O. Harmaala, L. E. Moore.*

COLAIZZI, ALBERT J., East Boston, Mass. (Born June 27, 1913, Boston, Mass.) Education: 1927–30, English High School; 1931–33, Lowell Institute. Experience: February 25, 1931, to date,

with Metropolitan District Water Supply Commission as senior engineering aid, as draftsman on general civil engineering work, and also draftsman on architectural work. Refers to *C. L. Coburn, K. R. Kennison, F. B. Wilkins, F. E. Winsor.*

HALLORAN, RICHARD, Newton Highlands, Mass. (Born February 5, 1914, Boston, Mass.) Graduated, 1936, from Massachusetts Institute of Technology, degree of B.S. in building engineering and construction. Experience: July, 1936, to February, 1937, with Alfred W. Lawson, Boston, appraising industrial properties and land damage cases; February, 1937, to May, 1937, with Joseph Selwyn, C.E., Belmont, on general surveying practice in and around Boston; June 1 to date, with Tremaglio Brothers, General Contractors, of Waterbury, Conn., on the new United States Post Office at Mansfield, Mass., as assistant superintendent. Refers to *J. D. Mitsch, H. G. Protze, C. M. Spofford, W. C. Voss.*

KENERSON, WALDO IRVING, Providence, R. I. (Born August 26, 1907, Lynn, Mass.) Graduated, 1929, from Massachusetts Institute of Technology, degree of B.S., in architectural engineering. Experience: June, 1929, to March, 1931, field engineer, designer, estimator and superintendent of construction, with the Aberthaw Company, marine department, and November, 1931, to March, 1933, field engineer on the new building for the Christian Science Publishing Society, Boston; March, 1933, to September, 1934, designer, with Chrysler Corporation, Detroit, Mich.; September, 1934, to August, 1935, awarded a graduate Scholarship at Massachusetts Institute of Technology, and under Prof. Glennon Gilboy and Mr. D. W. Taylor conducted research in soil mechanics, receiving a master of science degree upon termination of the work; August, 1935, to October, 1936, senior draftsman in charge of all design of precision and research testing apparatus in the soils laboratory, United States Engineers Office, Eastport, Me.; October, 1936, to present time, chief of soils laboratory, United States Engineers Office, Providence, R. I., in charge of all research work and analyses incident to the Flood Control program for the Connecticut River Watershed; October, 1937, appointed by Vice-President Adams of Brown University as special lecturer in soil mechanics for the academic year 1937–38. Refers to *W. R. Benford, G. Gilboy, G. S. Gould, J. D. Mitsch, D. Peabody, Jr., D. W. Taylor.*

RANDAZZO, WALTER ANTHONY, Chelsea, Mass. (Born April 28, 1914, Lynn, Mass.) During summer of 1934 at Harvard Engineering Camp, Center Harbor, N. H. Graduated, 1936, from Tufts College, B.S. degree in civil engineering. Experience: November, 1936, to June, 1937, in building department and water department, city of Chelsea; January, 1937, to May, 1937, taught physics, chemistry and science at Chelsea evening high school. Now with B. Perini & Sons, Inc., on survey work. Refers to *E. S. Averell, H. P. Burden, A. Haertlein, F. N. Weaver.*

WHITE, JULIAN HERBERT, Brewer, Me. (Born August 27, 1902, Springfield, Mass.) Education: Rensselaer Polytechnic Institute, September, 1922, to February, 1924; Northeastern University, February, 1925, to June, 1925, and summer; Lehigh University, February to June, 1926; Massachusetts Institute of Technology, October, 1932, to June, 1933, course in soil mechanics. Experience: March, 1924, to April, 1925, with Durkee, White & Towne, engineers, Springfield, and September to March, 1928, transitman, computer and chief of party on surveys, water lines and sewers; New England Power Company, November, 1926, to June, 1927, field engineer on construction; Turners Falls Power and Electric Company, April, 1928, to March, 1930, on power plant design and resident engineer on construction of Cobble Mountain Power Plant; Central Maine Power Company, April to October, 1930, assistant engineer in charge of power house erection; L. E. McLaughlin Company, contractors, June to October, 1931, assistant to superintendent on bridge construction; R. H. Newell Company, contractors, June to November, 1934, in charge of concrete construction sewage disposal plant, Monson, Mass.; May to October, 1935, in charge of construction of pump station, Sterling, Mass.; X. Henry Good-

nough, Inc., October, 1935, to January, 1936; November, 1934, to April, 1936, on property survey, and on concrete design water purification plant, Norwood, Mass.; Alden Hydraulic Laboratory, January to November, 1936, assistant on hydraulic research and model tests; McClintock & Craig, engineers, Springfield, Mass., November, 1936, to April, 1937, as resident engineer on reconstruction of paper mill. At present, designer, with Bangor Hydro-Electric Company, Bangor, Me. Refers to *C. M. Allen, E. S. Averell, L. J. Hooper, D. W. Taylor.*

For Transfer from Grade of Junior

Bowie, John Henderson, Milton, Mass. (Born September 23, 1903, Hyde Park, Mass.) Education: Graduated from Northeastern University, degree of B.C.E., in 1925. Experience: 1922–24, rodman, co-operative plan, town of Brookline; 1924–25, rodman, with H. L. White, C.E., Braintree, Mass.; March to October, 1926, transitman and chief of party, with Robert Smith, surveyor, Boston; 1926 to 1930, engineering department, town of Milton, chief of party on location and town surveys; 1930 to date, assistant town engineer, Milton, Mass. Refers to *H. B. Alvord, C. F. Joy, Jr., F. J. Maynard, G. H. Meserve.*

Calderara, Oral Joseph, Templeton, Mass. (Born February 26, 1909, Barre, Vt.) Graduated from Northeastern University, 1930, degree of B.C.E., with honor, and July, 1937, degree of B.S. in civil engineering. Experience: May to August, 1927, with McClintock & Woodfall, engineer, inspector supervising the construction of sewers at Winchendon, Mass.; August, 1927, rodman with J. J. Van Valkenburgh, Framingham; May to September, 1928, assistant to Stanley G. Kendall, city engineer, Gardner, Mass., as rodman and inspector on construction work; September, 1928, to June, 1930, on co-operative plan with engineering division of city of Waltham, Mass., transitman on municipal survey work, draftsman, inspector on construction of the Waverley Oaks trunk sewer; June to August, 1930, assistant to Mr. Kendall, Gardner, engineer supervising the construction of concrete pavement; April to December, 1931, engineer, inspector supervising construction of sewers in Canton, Mass., in employ of Whitman & Howard, Boston; August, 1932, to January, 1933, draftsman with Vermont State Highway Department; August, 1933, to August, 1935, observer in charge of field survey party doing work along Atlantic coast, as draftsman, computer with United States Coast and Geodetic Survey, Washington, D. C.; August, 1935, to January, 1936, employed by city of Gardner, Mass.; Fay, Spofford & Thorndike, Boston; Vermont State Highway Department, as estimator, chief of party, draftsman and transitman on road construction, respectively; April to May, 1936, resident engineer, supervising construction of sewers at Hampton Beach, N. H., under Frank A. Barbour, Boston; at present with Massachusetts Department of Public Health as a junior sanitary engineer. Refers to *F. A. Barbour, F. W. Haley, P. F. Howard, F. H. Kingsbury, A. D. Weston.*

De Serio, James N., Buffalo, N. Y. (Born December 19, 1910, Vastogirardi, Italy.) Was graduated, 1935, from Northeastern University, degree B.S. in civil engineering, with honor. Received Desmond FitzGerald Scholarship in 1934. Experience: During alternate five-week co-operative work periods, October, 1931, to December, 1932, with city engineer of Newton as rodman and transitman on preliminary, final and construction surveys; January, 1933, to March, 1933, with L. P. Federico & Sons, on water main construction; May to July, 1933, with Baldwinville, N. Y., water department, as field engineer laying out extension to waterworks plant; August, 1933, to May, 1935, with city engineer of Newton, as rodman and transitman; May to October, 1935, with Concrete Steel Company, as draftsman and steel detailer laying out reinforcing for concrete work; October, 1935, to present time, with Truscon Steel Company, as follows: October, 1935, to March, 1936, detailer and draftsman, laying out reinforcing steel, steel joints, steel roof decks, bridge floors, structural steel trusses and radio towers; March to September, 1936, as "checker" of detail drawings and shop orders for above-men-

tioned products; September, 1936, to present time, district engineer in the Buffalo office covering western New York State, including supervision of all engineering work for the company, making designs and detail plans, shop drawings, estimates of quantity for steel mill buildings, structural steel, reinforcing steel, joists, roof deck, steel sash and doors and allied products. Refers to *H. B. Alvord, C. O. Baird, C. S. Ell, A. E. Everett, E. A. Gramstorff.*

HEANEY, FRANK L., Braintree, Mass. (Born March 24, 1908, Braintree, Mass.) Graduated from Northeastern University, 1929, with degree of B.C.E.; 1929–30, Northeastern University Law School (evenings). Experience: Co-operative work, 1926–29, rodman and transitman, with H. L. White, Braintree; engineering department of Milton as transitman; draftsman with Metcalf & Eddy of Boston, and as rodman on West Concord sewer layout; with S. W. Perkins of North Scituate as transitman on Plymouth County road layout; with C. Fred Joy of Milton as transitman and inspector on sewer construction; with A. C. Peters of Boston, as chief of party on real estate development; June, 1929, to November, 1933, with city of Revere engineering department as civil engineer, Grade II; December, 1933, to date, with Braintree sewer department, as chief of party and assistant superintendent. Refers to *G. F. Brousseau, S. M. Ellsworth, P. F. Howard, C. F. Joy, Jr., G. H. Meserve.*

LINDGREN, OSCAR R., Stamford, Conn. (Born October 8, 1901, Ansonia, Conn.) Graduated from Northeastern University, 1926. Since then with New York, New Haven & Hartford Railroad Company, in the engineering department; now in charge of drafting room, maintenance department of the New York District of the New Haven Division. Refers to *H. B. Alvord, C. S. Ell, F. F. Hampe, G. H. Melcher.*

MARKHAM, MARTIN JAMES, Stoneham, Mass. (Born June 17, 1907, Ware, Mass.) Graduated from Northeastern University, 1931, degree of B.C.E. in civil engineering, and degree of B.S.E. in 1932. During co-operative periods at Northeastern University, 1928–31, assistant engineer on building construction for Morton C. Tuttle; rodman, transitman and draftsman for Whitman & Howard, John F. Rand, Davis & Abbott and town of Swampscott; 1931–32, transitman for town of Swampscott; 1932–33, engineer for town of Stoneham; 1933–34, engineer on C. W. A. project; 1934 to date, engineer for town of Stoneham, Department of Public Works. Refers to *H. B. Alvord, C. O. Baird, Jr., A. E. Everett, Jr., E. A. Gramstorff, E. J. O'Connor.*

VOLPE, SABESTINO, Atlantic, Mass. (Born October 1, 1906, Italy.) Graduated from Quincy, Mass., High School, 1925 (college course). Graduated from Northeastern University, degree of B.C.E. in 1928. Experience: 1928 to spring of 1929, with Corphiles Helph, engineer, Quincy, Mass.; L. P. Soule Company; 1929–30, supervised covered tennis courts at Brookline Country Club, under J. M. Tobin Company; 1930–32, construction engineer and assistant superintendent of construction with Capobianco Construction Company; 1932–34, in business for himself; 1934 to present time, construction engineer and assistant superintendent, Eastern Massachusetts Street Railway Company. Revers to *H. B. Alvord, C. O. Baird, Jr., C. S. Ell, F. B. Walker, C. A. Wolfrum.*

WHITE, CHARLES A., North Falmouth, Mass. (Born October 24, 1907, Cambridge, Mass.) Graduated from Northeastern University, degree of B.C.E., in 1929. Experience: September, 1929, to June, 1931, instructor in civil engineering at Northeastern University; assistant to George A. Griffin, civil engineer, Falmouth, Mass., as chief of party, instrumentman and draftsman on watershed survey and studies, waterworks extensions; highway layouts, grades, etc.; assessors' maps and survey and land surveying; June to September, 1936, dredging inspector on Boston Harbor and Cape Cod Canal for United States Engineers; resigned and started private practice in Falmouth, Mass. Refers to *H. B. Alvord, C. O. Baird, Jr., C. S. Ell, A. E. Everett, Jr.*

For Transfer from Grade of Student

GIBBS, JAMES BERESFORD, Boston, Mass. (Born October 31, 1903, Balboa,

C. Z.) 1916 to 1920, private academy, Panama, C. Z.; 1926–29, Northeastern University; graduated, 1936, with degree B.S. in civil engineering. Experience: Engineering draftsman with Massachusetts Geodetic Survey, Boston, Mass. Refers to *H. B. Alvord, C. O. Baird, Jr., A. E. Everett, Jr., E. A. Gramstorff.*

Mitchell, William Henry, Dorchester, Mass. (Born September 22, 1914.) Graduated from Northeastern University, degree of B.S. in civil engineering, 1937; while at Northeastern University, co-operative periods, was electrical tester of wire and cables with Boston Insulated Wire and Cable Company, July, 1934, to September, 1936; rodman with New York, New Haven & Hartford Railroad Company, Boston, 1937; at present, with New York, New Haven & Hartford Railroad Company in Boston as rodman, and as rodman and acting chief of party on special relocation survey at Providence, R. I. Refers to *H. B. Alvord, C. O. Baird, Jr., A. E. Everett, Jr., E. A. Gramstorff.*

Perdikis, Harry Samuel, Providence, R. I. (Born June 25, 1912, Lawrence, Mass.) Graduated from Northeastern University, degree of B.S. in civil engineering, in 1936. Experience: September, 1936, to present time, with United States Engineer Office, Providence, R. I., as under engineering aid, making sounding surveys of rivers and harbors, plotting and making estimates of volumes, keeping records of and making estimates of costs of dredging operations. Refers to *H. B. Alvord, C. O. Baird, Jr., A. E. Everett, Jr., E. A. Gramstorff.*

Wiseman, John Franklin, Malden, Mass. (Born December 14, 1912, Malden, Mass.) Graduated from Northeastern University, degree of B.S. in civil engineering, in 1936. During co-operative periods at Northeastern University, and May to September, 1935, employed by John F. Rand, civil engineer and surveyor, Melrose; October, 1935, to present time, with Joseph Selwyn, civil engineer and architect, Belmont, Mass. Now chief engineer on all work handled by Mr. Selwyn. Refers to *H. B. Alvord, C. O. Baird, Jr., C. S. Ell, A. E. Everett, Jr.*

ADDITIONS

Members

William H. Balch, 302 Main Street, Stoneham, Mass.

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Herman J. Shea, Massachusetts Institute of Technology, Cambridge, Mass.

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Juniors

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Philip G. Smith, 11 Pickett Street, Beverly, Mass.

DEATHS

Edgar S. Dorr	Oct. 5, 1937
William C. Hawley	Aug. 16, 1937
Francis H. Kendall	Oct. 7, 1937
Frank A. McInness	Aug. 9, 1937
Joseph F. Ross	Oct. 3, 1937
Edgar P. Sellew	Oct. 20, 1937

BOOK REVIEW

"Design of Reinforced Concrete Structures," by Dean Peabody, Jr.

In the preparation of this textbook on reinforced concrete design the author has interwoven fundamental theory with practical design in a most satisfactory manner

and with inductive pedagogical intent. In a subject so likely to be changed in its practical application by new impericisms of committee routine and code regulations, or change in cement technology, it is futile to attempt an altogether rigid plan for design practice. This the author has not done. He has wisely introduced a generous supply of illustrative problems to accomplish this end, but has discussed a sufficient amount of structural theory properly related to the analysis of rigid frames to enable the student and the engineer to grasp the attack of the problem rather than merely to solve it by routine procedure. It is refreshing to see a textbook of scope in its field which gives ample weight to —

(*a*) Fundamental theory.
(*b*) Practical design.
(*c*) Discussion of new phases of the effect of the materials used.
(*d*) A study of economic design.

This book covers its field in a manner which is interesting and obviously useful to the student, and is well grounded in structural theory.

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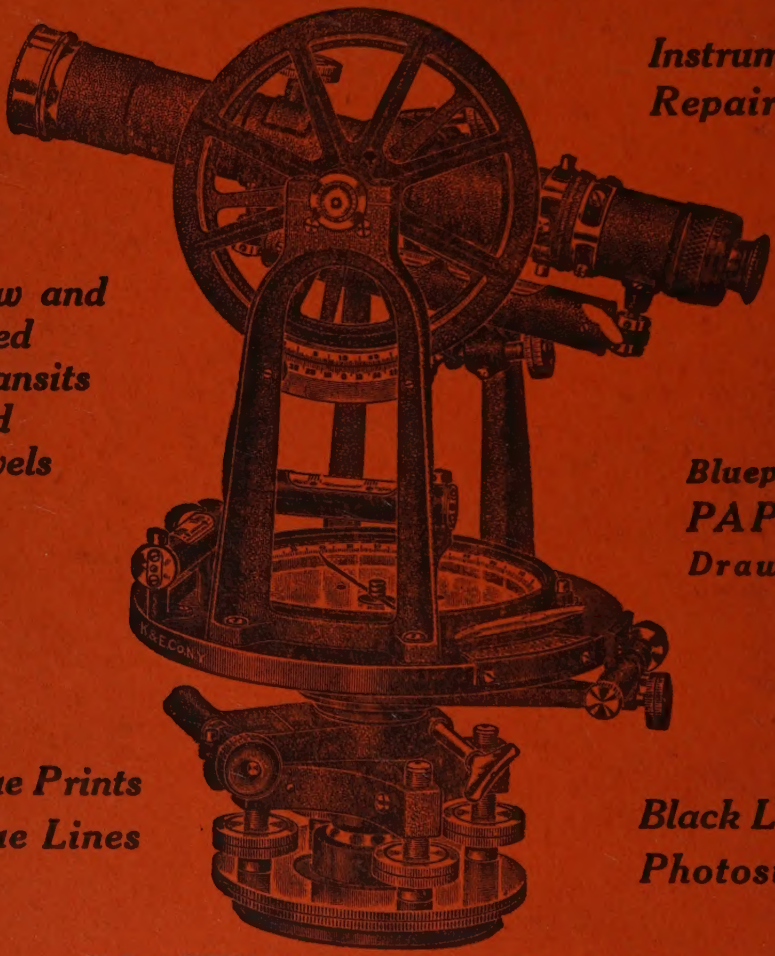

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